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OPERATIONS AND SERVICE MANUAL
MODEL TSC-820
SIGNAL CONDITIONER

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OPERATIONS AND SERVICE MANUAL

MODEL TSC-820

SIGNAL CONDITIONER

RECORDER SYSTEMS DIVISION
GULTON INDUSTRIES INC.,
GULTON INDUSTRIAL PARK
EAST GREENWICH, R. I. 02818



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MODEL TSC-820 SIGNAL CONDITIONER

DESCRIPTION

1.1 GENERAL DESCRIPTION

The TSC-820 Signal Conditioner is a plug-in module for use in Gulton's 4, 6 and 8 - channel portable recorders. This Signal Conditioner has a true differential input with a maximum sensitivity of 10 uv/chart division. The conditioner contains a DC power supply for excitation of external measurement circuits (typically strain gauge bridge configurations) and also features fixed-range, zero-suppress with calibrated dial for expanded-scale recording of AC signals riding on DC levels.

1.2 SPECIFICATIONS, GENERAL

The TSC-820 Signal Conditioner is designed to operate on either of two Gain ranges, identified as the High-Gain Mode and Low-Gain Mode. Selection of the Gain Mode is governed by the Gain Mode Switch (the red knob concentric with the Attenuator Switch). The only operational difference between the two Gain ranges (other than sensitivity) is the Zero-Suppress scale factor. Using the High-Gain Mode, the Zero-Suppress ranges are -10 and -100 Millivolts, full scale; with the Low-Gain Mode, the ranges are -10 and -100 Volts, full scale.

FOR DETAILED SPECIFICATIONS

SEE TABLES ON FOLLOWING PAGES

1.2-1 SPECIFICATIONS - TABLE A

ITEM	SPECIFICATIONS COMMON TO BOTH HIGH & LOW GAIN MODE	
Input Configuration	Differential, balanced to Floating Shield	
Input Impedance	1 Megohm to each Input to Floating Shield	
Calibration	Internal $\pm 1\%$ (100 mv injected at input when in CAL pos.) Adjust GAIN for 20 Div. to give 1% system calibration.	
Span Control	Allows $\pm 10\%$ adjustment of DC excitation voltage	
DC Excitation	+5, +10 and +12 Volts, selected by internal Jumper placement	
DC Excitation Stability	Line Regulation, 0.1% 105-135 VRMS Load Regulation, 1% 1 to 50 ma Ripple, 1 mv maximum Temperature, 0.5% / 10°C maximum Current Limit, 65 ma typical	
Gain Control	Range: 10 through 110% of Calibrated Gain (Screw-driver control)	
Stylus Position Control	Range: $\pm$ full scale with 0 signal input	
Frequency Response (limited by the Recorder in which Sig. Condition- er is used)	DC - 35 Hz, 50 Div P/P 1 db. DC - 50 Hz, 20 Div P/P 1 db. DC - 100 Hz, 8 Div P/P 3 db.	Typical of Gulton's Portable Recorders
Noise	1 Div. maximum with 350 Ohms across input at maximum calibrated sensitivity	
Gain Mode Switch	Concentric with Attenuator Switch; 4 positions, namely, "OFF", "CAL", mv/Div." and " μ v/Div."	
Zero Drift	1 Div./3°C maximum, at Max. Calibrated Sensitivity 1 Div. 8 hours - constant ambient temperature	
Gain Stability	1/2% / 10°C., 1/2% 105-135 VRMS	
Environmental Tolerances	Operating Temperature Range: 0 to 45°C. Max. Vibration Tolerance: 2 g's, 2 to 100 HZ	

1.2-2 SPECIFICATIONS - TABLE B

ITEM	<u>Specifications Differing According to Gain Mode</u>	
	<u>HIGH GAIN ONLY ($\mu\text{v}/\text{DIV}$)</u>	<u>LOW GAIN ONLY (mv/DIV)</u>
Sensitivity, Basic	10 μv / Division	10 mv / Division
Attenuator Positions	10, 20, 50, 100, 200, 500, 1000 μv / div.	10, 20, 50, 100, 200, 500, 1000 mv / div.
Common Mode Voltage	± 7.5 Volts DC Max., Fuse protected at ± 25 Volts	300 Volts DC Max. (between signal inputs & common)
Common Mode Rejection	60 db Min., DC to 200 Hz	60 db Min.
Zero Suppression	2 ranges, independent of attenuator pos. ± 100 mv and ± 10 mv, front panel SW and 10-turn calibrated pot., Reso- lution $\pm 0.1\%$ Accuracy, $\pm 2\%$ of F. S.	2 ranges: ± 100 Volts and ± 10 Volts
Bridge Controls	Zero Balance (R Bal) - 10-turn Pot., balance range of $\pm 10\%$ F.S. Zero unbalance, WITH gage factor of 3 Bridge Cal - Momentary push-button SW to insert Cal. resistor in bridge arm. Provision for mounting Cal. Res. on front panel.	Not applicable

INSTALLATION

2.1 MECHANICAL INSTALLATION

Assembling the TSC-820 Module to the Recorder Frame

The entire Signal Conditioner Module is merely inserted into the appropriate space provided within the Recorder Frame. To make the insertion, hold Module with top and bottom edges of the Printed Circuit Board () aligned with the Guide-Slots in the Recorder.

Apply pressure to the left-hand edge of the Module Front Panel and press firmly inward until face of Module Panel is flush with face of Recorder. Final seating pressure may be applied to the Module knob-handles.

After Module is fully seated, the Module is firmly secured mechanically, to the Recorder Main Frame. In addition, the necessary internal electrical connections are established so that the Signal Conditioner/Recorder unit is ready for operation as soon as it is properly connected to its signal source, as explained in the following "Electrical Installation" instructions.

2.2 ELECTRICAL INSTALLATION

Information in this sub-section tells how to connect the Signal Input Cable to the Signal Conditioner/Recorder unit; also how to connect Internal Bridge-Completion Resistors (when required).

2.2-1 PRELIMINARY INFORMATION

The signal-source input is conveyed to the Signal Conditioner/Recorder unit via a suitable shielded-type cable.

To provide for the ready interchange of input sources, a plug-in arrangement is used for connecting the Input Cable to the Signal Conditioner/Recorder assembly.

The Input Connector Plug (assembled to end of Cable) inserts into a mating Receptacle located on top or rear panel of the Recorder Frame.

The only electrical wiring required in the field, to install the Signal Conditioner, is (1) Connection of the Input Signal Cable
(2) In certain Bridge Mode applications, connections of one or more Bridge-Completion Resistors within the Signal Conditioner.

2.2-2 SIGNAL INPUT CABLE, DESCRIPTION

The required Cable (to be procured by customer) is a standard, 2, 3 or 4 conductor (depending on application) shielded type, of adequate length to reach between signal-source equipment and the Recorder Receptacle. Cable must be of good instrumentation grade.

2.2-3 INPUT CONNECTOR PLUG, DESCRIPTION

This Plug is a standard audio type, made by SWITCHCRAFT (PN-14FL5F). A Connector Plug, or set of Plugs (1 for each channel) is supplied with each Recorder. Additional Plugs, if required, are readily obtainable from most electronic parts distributors.

Design of the Plug is indicated in Figure 2-4. As seen in Figure 2-4C, the Plug has 5 Pins, numbered 1 through 5, reading clock-wise from the Keyway. These numbers are molded onto the end of Plug Insert.

The Input Connector Plug Pins have various functions, as follows:

<u>Pin No.</u>	<u>Pin Function</u>
1	Non-Inverting (Sig. +)
2	Inverting (Sig. -)
3	Frame, Shield, Excitation Return
4	R Bal - Connects to Pin 1 or 2 for Bridge Balance
5	DC Excitation (Positive with respect to Pin 3)

2.2-4 ALTERNATIVE WIRING PLANS FOR SIGNAL INPUT CONNECTIONS

General Explanation

The signal source is connected to the Signal Conditioner in various ways, depending on Mode of operation, also on source characteristics.

For Voltage Mode Operation, there are 4 alternative wiring plans, as shown in Figures 2-5 through 2-8. Select whichever one is appropriate, according to the stated conditions.

When using Voltage Mode, the only installation wiring required consists of the external, input-cable and plug assembly; there are no internal connections to be made within the Conditioner.

For Bridge Mode Operation, there are 3 alternative input wiring plans, as shown in Figures 2-9 through 2-11. Here, too, the appropriate plan is selected according to the limiting conditions as stated.

Note that for two of the Bridge Mode applications (Figures 2-10 and 2-11), in addition to connecting the external Input Cable and Plug, it is also necessary to connect 2 or 3 Bridge Completion Resistors, within the Signal Conditioner, as indicated in these diagrams.

Note - Refer to Bridge Mode operating instructions (3.3) before actual instalation of resistors.

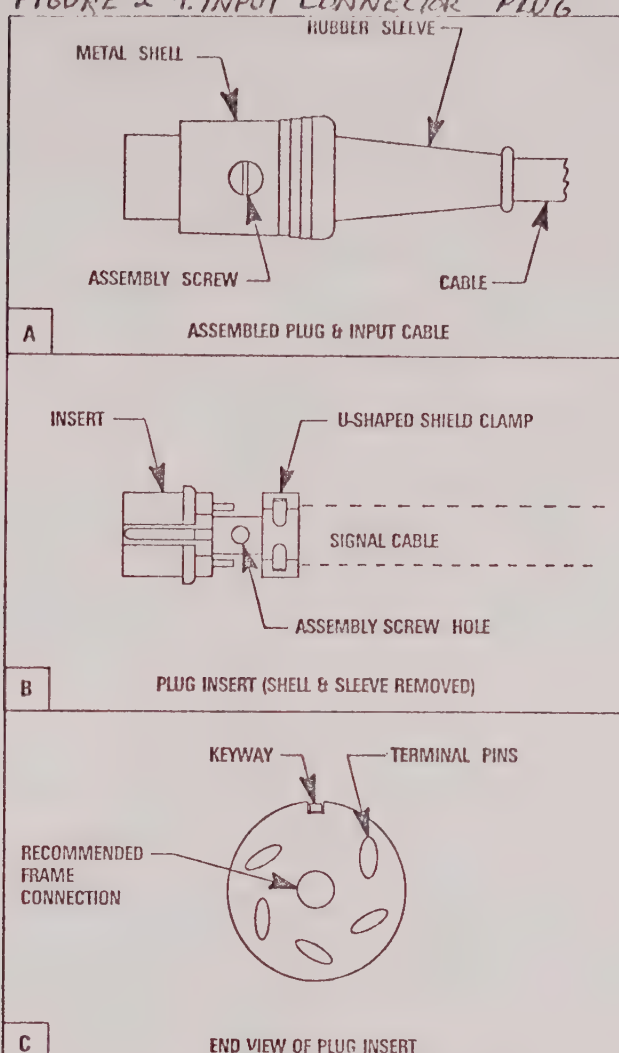
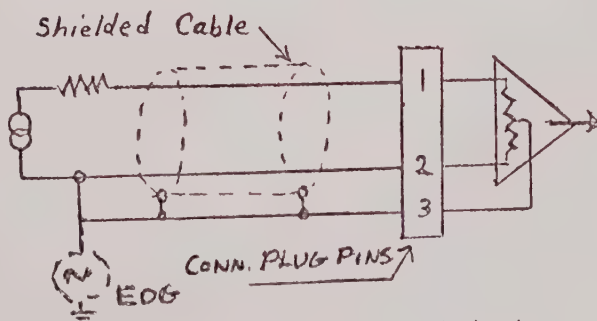


FIGURE 2-5 WIRING DIAGRAM

Limited to: Voltage Mode recording from single-ended, "floating" source



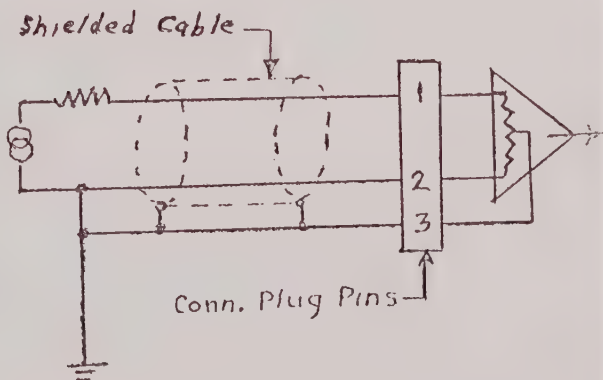
Note that Shield is connected at both ends.

The off-ground voltage on which the signal is riding must not exceed 125 VRMS (when recording from off-ground sources).

The connections to Pins 1 and 2 can be reversed if a change in polarity is desired.

FIGURE 2-6 WIRING DIAGRAM

Limited to: Voltage Mode recording from Single-Ended Grounded Source



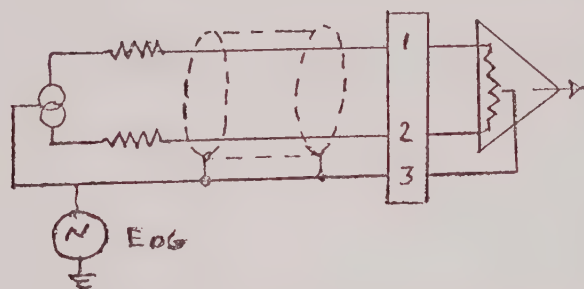
Note that Shield is connected at both ends.

Connections to Pins 1 and 2 can be reversed if a change in polarity is desired.

VOLTAGE MODE - ALTERNATIVE INPUT WIRING (Continued)

FIGURE 2-7 WIRING DIAGRAM

Limited to: Voltage Mode recording from Balanced "Floating" Signal Source



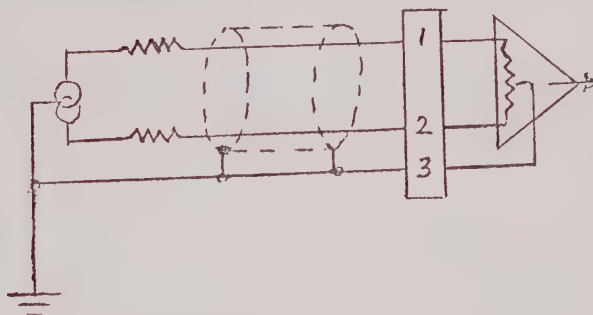
Note that Shield is connected at both ends.

The Common Mode Voltage (Voltage between Pins 2 & 3 or 1 & 3) must not exceed 7.5 Volts DC in the High-Gain Mode or 300 Volts in the Low-Gain Mode.

The Off-Ground Voltage (EOG) must not exceed 125 VRMS.

FIGURE 2-8 WIRING DIAGRAM

Limited to: Voltage Mode recording from Balanced-to-Ground Source



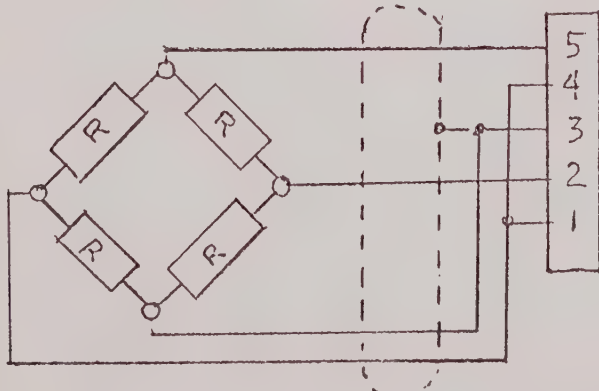
Note that Shield is connected at both ends.

The Common Mode Voltage (Voltage between Pins 2 & 3 or 1 & 3) must not exceed 7.5 Volts DC in the High-Gain Mode or 300 Volts in the Low-Gain Mode.

2-2-4B BRIDGE MODE - ALTERNATIVE INPUT WIRING

FIGURE 2-9 WIRING DIAGRAM

Limited to: Bridge Mode recording from 4-Element External Strain Gauge (full Bridge).



Connect Shield at either or both ends.

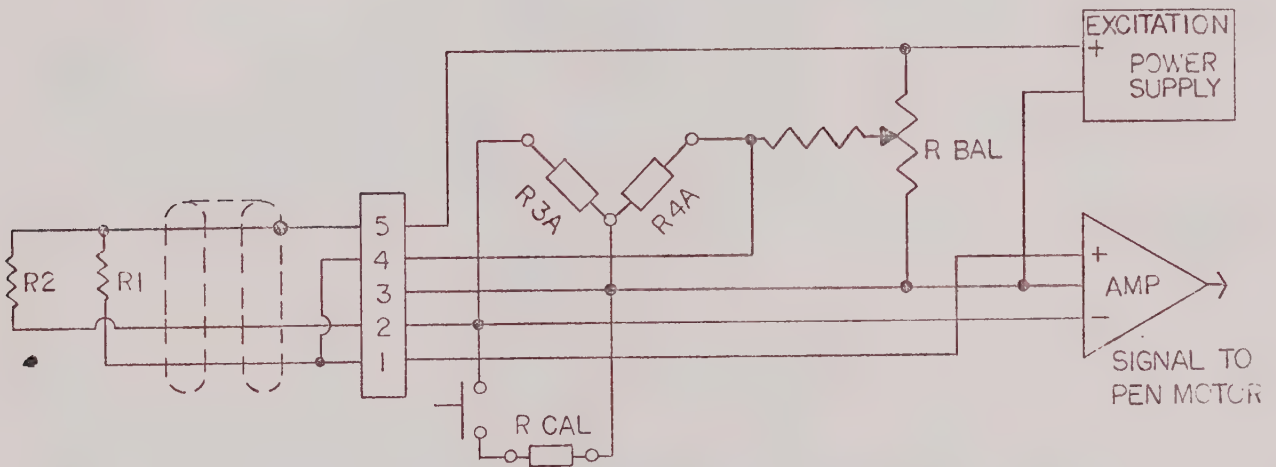
Use twisted, shielded cable for minimum noise pick-up.

Note: NO Internal Bridge-Completion Resistors required in this application (with a full External Bridge).

BRIDGE MODE - ALTERNATIVE INPUT WIRING (Continued)

FIGURE 2-10 WIRING DIAGRAM

Limited to: Bridge Mode recording
from External, 2
Element Strain Gauge



Note that Shield is connected at one end only.

Use same wire size for all leads.

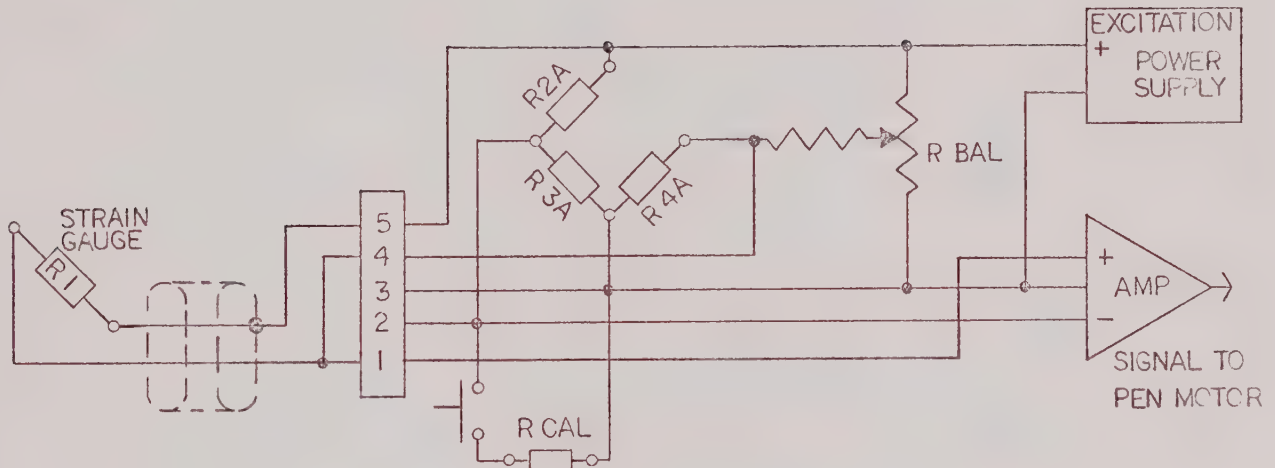
Install 2 Internal Bridge-Completion Resistors (R_{4A} & R_{3A}) as shown. Value should equal External Arm Resistance, R .

Use 0.1% or better, wire-wound Resistors.

R_1 - R_2 external connections.

R_1 - R_4 and R_2 - R_3 external connections disallowed.

Limited to: Bridge Mode recording
from Single-Element,
External Strain Gauge



Use same wire size for all leads.

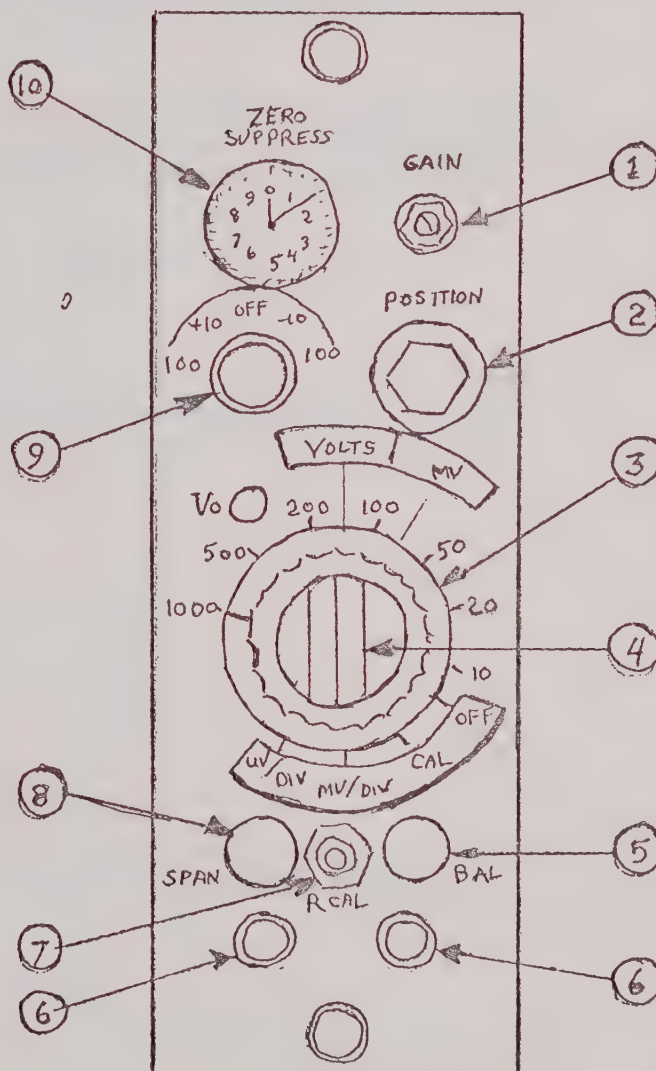
Install 3 Bridge-Completion Resistors (R4A, R2A, R3A) as shown. Two of the Resistors (R2A & R3A) can be of arbitrary resistance value, as long as they are matched to within $\pm 0.2\%$. The third Resistor (R4A) should be matched to within $\pm 0.2\%$ of the unstressed Strain Gauge resistance.

Note that in this application (using single-element Strain Gauge) the TSC-820 Signal Conditioner allows for only a two-wire connection to the input. Consequently, significant errors can occur due to changes in lead wire resistance caused by temperature variations. It is therefore highly recommended that a dummy Gauge be used instead of the third resistor (R2A) within the Conditioner. The dummy or Compensator Gauge should be located in close proximity to the Active Gauge to minimize any temperature differential between it and the Active Gauge. For proper connection, see Figure 2-10.

Connection for R1 External shown in Figure 2-11, for opposite pen deflection, R2 can be made external with R1 internally connected.

Legend

- (1) Gain Pot Adjustment
- (2) Position-Control Switch and Lock
- (3) Attenuator Switch (Black Knob)
- (4) Gain Mode Switch (Red Knob)
- (5) Bridge R Balance (10-Turn)
- (6) Binding Post for Cal. Resistor Installation
- (7) R Cal Push-Button Switch
- (8) Span Pot Knob (10-Turn)
- (9) Zero-Suppress-Function Switch
- (10) Zero-Suppress Pot (10-Turn)



FRONT PANEL CONTROLS

Figure 3-1

OPERATION

3.1 INTRODUCTION

Two separate sets of operating instructions are provided for the TSC-820 Signal Conditioner, one for Voltage Mode (3.2) and another for Bridge Mode (3.3) since a different operating procedure is required for each Mode.

With Voltage Mode operation, the Signal Conditioner is used as a straight-forward voltage pre-amp; therefore the Bridge Controls and the internal excitation voltage are not used.

With Bridge Mode operation, the Signal Conditioner is used to measure signals from a Wheatstone Bridge configuration, for which purpose both the internal excitation voltage and the Bridge Controls are employed.

3.2 VOLTAGE MODE OPERATING PROCEDURE

3.2-1 Initial Pre-Amp Set-up

Remove Signal Conditioner unit from Recorder Frame and check that there are no resistors tied to the Bridge-Completion Binding Posts, located on the small printed circuit sister board. Then replace Signal Conditioner in Recorder.

3.2-2 Initial Control Settings

- (1) Set Controls as follows:

Zero Suppress Switch	OFF
Gain Mode Switch	OFF
Attenuator Switch	1000
- (2) Disconnect the Input Conn. Plug.
- (3) Turn ON Recorder Main Power Switch with the Chart Drive OFF. Allow Recorder and Signal Conditioner to warm up for 5 minutes, minimum.
- (4) Set Chart Speed for 0.5 mm/second.

3.2-3 Zero Base Line Set-up

- (1) Decide where the Zero Baseline is best positioned. For normal operation, where + and - signals will be recorded, the base line is best set at center scale. If only Pos. or Neg. signals are to be recorded, left or right chart margin, respectively, would be the choice.
- (2) Having decided where zero baseline is to be, unlock and turn the Position Control to set Stylus to the desired baseline position, then lock the Position Control.

3.2-4 Gain Calibration

After completing 3.2-3

- (1) Turn Gain Mode Switch to the CAL position, and
- (2) Adjust Gain Control Pot (using screwdriver) for 20 div. deflection from the zero baseline. NOTE: if the zero baseline has been set at the right - hand margin, it will be necessary before making the Gain Calibration to shift baseline to chart center, and then return it to right-hand setting after Gain Calibration is complete.

3.2-5 Offset Voltage Check

After Gain is properly calibrated

- (1) Return Gain Mode Switch to the OFF position and recheck the zero baseline position.
- (2) Place Gain Mode Switch in the MV/DIV position and advance the Attenuator Switch from 1000 to 10.

o

The Stylus should remain within one division of the zero baseline. If not, adjust.

- (3) Adjust the V. Control (accessible through the front panel) to reposition the Stylus to the zero baseline.
- (4) Return Gain Mode Switch to OFF and Attenuator Switch to 1000.

3.2-6 Recording the Signal - Initial Procedure

- (1) Connect input signal to the Recorder
- (2) Turn Chart Drive on
- (3) Set the Gain Mode and Attenuator Switches according to the dictates of the input signal amplitude.

3.2-7 Recording the Signal - Secondary Procedure If Required (to correct non-symmetrical stylus trace)

Certain input signals-with both AC and DC components- may cause the Stylus to swing further to one side of the pre-set zero baseline than to the other. If so, one of two corrective measures will be required, namely:

3.2-7A Position Control Re-Adjustment

Provided the DC offset is not greater than 50% of the F.S. range (at the existing Attenuator setting), the Stylus Position Control can be

- 3.2-7A re-adjusted to establish a new zero baseline and obtain a symmetrical Stylus sweep.

OR

3.2-7B Zero Suppression Operation

If the above Position Control Re-adjustment is impracticable, Zero Suppression can be used to offset DC signals up to 100 Volts. Typically, Zero Suppression allows a more sensitive Range Switch setting when large DC signals are present, while at the same time allowing measurement of the total signal amplitude.

Proceed as follows:

- (1) First, without using Zero Suppression, record the signal to be investigated and note the approximate peak-to-peak amplitude of the AC as well as DC signal components. Best results are obtained using a margin zero, that is, by initially setting the baseline trace at the left or right-hand margin of its channel (left, if DC component is positive; right, if negative). To set this "zero", use the Position Control, while the Function Switch is in OFF position. DO NOT TOUCH THE POSITION CONTROL THEREAFTER, as all readings will be taken from this initial "zero".

- (2) Setting the Suppression Controls

In the mv/DIV Gain Mode, the Zero Suppress ranges are -10 and -100 mv., which are selectable by the Zero Suppress Function Switch.

In the mv/DIV Gain Mode, the Suppress ranges are -10 and -100 Volts.

A precise setting of any voltage within these ranges is made by means of the 10-turn Calibrated-Dial Suppress Potentiometer.

Example:

To suppress a 71 mv DC signal, the High-Gain Mode (uv/DIV) would be selected, and the Suppress Function Switch placed in the -100 position (-100 mv full scale suppression capability). The 10-turn Calibrated Dial would then be set to 71.

- (3) Recording the Signal

Turn the Attenuator Switch to a sensitivity which allows the AC signal component to stay on scale. A minor adjustment of the Zero Suppress Pot may be needed to keep the trace on scale.

To determine the total signal amplitude, simply read the voltage off the chart (number of DIV. deflection from zero baseline times Attenuator setting) and add to this reading the setting of the 10-turn Dial times the suppression range.

3.3 BRIDGE MODE OPERATING PROCEDURE

3.3-1 Initial Set-up

- Before (a) setting the excitation level
(b) adding internal Bridge-Completion Resistors or
(c) making any Signal Input Connections

The Signal Conditioner should be checked out and set up according to the procedures given for Voltage Mode Operation (3.2-1 through 3.2-5)

3.3-2 Excitation-Level Selection

Having completed the Initial Set-up above, turn OFF Recorder power supply and remove the Signal Conditioner from the Recorder Frame.

The TSC-820 Signal Conditioner offers a choice of 4 voltage levels, namely, 5, 8, 10 or 12 V., governed by the positioning of a Jumper Plug.

The voltage level should be selected in accordance with (a) the Strain Gauge manufacturer's recommendations for the particular Gauge being used, and (b) the maximum loading capability of the Signal Conditioner's power supply. To select maximum allowable voltage levels for various Gauges, refer to the following table.

Example: For a 120 Ω Bridge, 5V. is the highest level which can be used.

VOLTAGE LEVEL	JUMPER POSITION	MAX. CURRENT	RESIST LEAD RANGE (Bridge Input)
5 V	1	50 mA	100 Ω to ∞
8 V	2	50 mA	160 Ω to ∞
10 V	3	50 mA	200 Ω to ∞
12 V	4	50 mA	240 Ω to ∞

3.3-3 Bridge Completion Resistors Installation

Locate and loosen the appropriate binding posts. Refer to Figure 2-9 through 2-11 for selecting resistors. Install required resistors and reinstall conditioner into recorder mainframe and turn recorder power on.

3.3-4 Zero Balance Procedure

- (1) Unload the measurement bridge, i.e., zero the bridge input, (zero strain, pressure, force, etc.) to give a balanced output -0 Volts.
- (2) Set the Attenuator to mid-range (200)
- (3) Set Gain Mode Switch to uv/DIV
- (4) Adjust R Bal Control to set Stylus to the zero baseline
- (5) Increase sensitivity to 10 uv/DIV and re-adjust R Bal if necessary to the zero baseline

3.3-5 Calibration

Note, for this procedure, choose any of the following 3 alternative methods, as appropriate (A, B or C)

A - Shunt Calibration

On the Signal Conditioner Front Panel, 2 terminals are provided for installation of a Shunt Calibration Resistor. After being so installed, this Resistor is connected across a Bridge Arm whenever the R Bal Switch is closed. When thus connected, the Shunt Resistor unbalances the Bridge, with the amount of unbalance corresponding to a fixed, static load on the Bridge. Typically, the Resistor is selected to represent an 80% F.S. load.

Shunt Calibration Procedure

With the Calibration Resistor in place in the Signal Conditioner and with Bridge connected and zeroed,

- (1) Hold the R Cal Switch and set the Attenuator Switch for a convenient scale deflection.
- (2) Read the voltage off the chart.

This voltage is the Bridge output for a calculated input, from which a scale factor can be calculated to relate volts to the engineering units of the Bridge input.

B - Calibration with a Known Bridge Load

Instead of a Shunt Resistor, it may be more desirable in some cases to use a known input to the Bridge, i.e., a calibrated mechanical load, pressure or strain input. The procedure is generally identical to that when using a Shunt Resistor; however, instead of using the Signal Conditioner R Cal Switch, apply the calibrated load, after first zero-balancing the Bridge.

Here, too, the chart read-out is in volts, and a scale factor can be calculated from the calibrated load.

C - Calibration for Direct Chart Read-out in Engineering Units

With this technique, voltage gain calibration of the Signal Conditioner is lost in favor of obtaining a direct readout in engineering units (u-strain, PSI, etc.).

To calibrate in this manner:

2

- (1) Zero the Bridge as previously described, then use either a Shunt Resistor or calibrated load to give a known output from the Bridge.
- (2) Set the Attenuator Control for a reasonable display of this calibrated signal (30 to 50 divisions deflection from the zero baseline - assuming zero baseline is set at left or right-hand chart margin).
- (3) The calibrated Bridge load should represent some percentage of the F.S. Bridge output, so adjust the GAIN Control on the Conditioner for that same percentage of F.S. chart deflection. Example: If the calibrated load represents an 80% F. S. Bridge output, adjust the Gain Control for exactly 80% F. S. deflection (40 divisions) from the zero baseline.
- (4) The Attenuator range is now calibrated to Full Scale Bridge output with a sensitivity of F. S. units/50 per division. The sensitivity on the other Attenuator ranges can be determined by the Attenuator Gain factors.

MAINTENANCE

4.1 PERIODIC PREVENTIVE MAINTENANCE, GENERAL

Detailed in this Section, under the headings "Preventive Maintenance", are those procedures deemed essential to insure the continuing operation of the TSC-820 Signal Conditioner at peak efficiency.

Under normal-use conditions, the recommended maintenance - both mechanical and electrical - should be performed at six-month intervals. Under severe operating conditions, the program should be repeated every 90 days.

4.2 Preventive Maintenance, Mechanical

4.2-1 Preliminary

Turn OFF all power.

Remove the Preamplifier from the Recorder by grasping the top and bottom Handle-Knobs and then pulling the entire Preamp Unit straight out.

4.2-2 Cleaning

Using suitable air hose, blow out loose dust and dirt.

Inspect for any foreign particles and remove if present.

Clean the Preamp Panel and Handle-Knobs with a moist cloth, then wipe dry with soft clean cloth.

4.2-3 Tightness Check

Inspect the Preamplifier and Power Supply for loose parts (transistors, plug-in components, resistors, condensers, controls, terminal boards, mounting boards, rectifiers, fuses, transformers, etc.).

Check that all panel-mounted components are securely in place, that all locking controls will lock securely, and that each Control Knob is tight on its shaft.

4.2-4 Damage Check

Inspect visually and by smell for burned or worn insulation, leaking or damaged resistors, condensers, transformers, etc. Inspect also for corrosion, rust, and electrical or mechanical abuse.

4.2-5 Replacement

Reinstall the equipment and fasten securely.

4.3 PREVENTIVE MAINTENANCE, ELECTRICAL

4.3-1 Note: The instructions to follow cover recommended electrical checks and calibrations of the Signal Conditioner only. Following completion of the Signal Conditioner maintenance, the total Signal-Conditioner/Recorder System also should be checked - for linearity and frequency response (per instructions in the applicable Recorder Manual).

4.3-2 Test Equipment Required

- (1) Digital Volt Meter - 4-1/2 Digit, 100 uv Resolution, 0.1% accuracy or better.
- (2) Extender Card - Gulton Model TAC 130.
- (3) Variable DC signal source.

4.3-3 Preparatory

It will be necessary to provide access to various internal adjustments while the Signal Conditioner is connected and operating. To accomplish this, remove Signal Conditioner from Recorder and insert in its place the TAC-130 Extender Card. Then plug the Conditioner into the connector on front of the Extender Card.

4.3-4 Initial Set-up

- (1) Turn ON Recorder main power, then set Chart speed to LOWEST setting.
- (2) Set the Signal Conditioner Controls as follows:
 GAIN MODE - off
 Zero Suppress - off
 Position Control - Center scale, zero baseline
- (3) Disconnect the Input Signal Cable
- (4) Remove all Bridge-Completion Resistors

4.3-5 Output V_o Adjustment

- (1) Set Gain Mode Switch to OFF
- (2) Using screw driver, set GAIN Control Max. CCW
- (3) Adjust Position Control for exact center scale Stylus position, and lock the Control
- (4) Re-set GAIN Control to Max. CW position
- (5) Adjust Output V_o Pot (R22) to re-set Stylus to exact center scale.
(For location of R22 refer to figures 4-)

4.3-6 Input V_o Adjustment

After completing Output V_o Adjustment,

- (1) Set Gain Mode Switch to MV/DIV
- (2) Without touching the Position Control, adjust Input V_o Pot (R12), accessible through Front Panel, for exact center scale Stylus position
- (3) Switch back and forth between MV/DIV and OFF, checking to assure there is no offset between OFF and MV/DIV., re-adjusting R12 if necessary.

4.3-7 Internal CAL Voltage Adjustment

- (1) Using a variable DC source and a DVM, insert a 20.0 mv signal at the input signal Connector. (for proper connection signal source, see Figure 2-5 Section 2)
- (2) Set operating controls thus;

 Gain Mode - uv/DIV
 Attenuator - 1000
 Zero Suppress - OFF
- (3) Adjust Gain Control for exactly 20 DIV deflection from zero baseline. (Check Zero Baseline by switching Mode Switch to OFF position).
- (4) Switch Gain Mode to CAL position. Stylus now should be at the same 20 DIV deflection observed in step (3); if not adjust R49 accordingly. (for location of R49 see Figure 4-)

4.3-8 Zero Suppress Calibration 9

- (1) Set the variable DC source (connected as in 4.3-7) to -100 mv, using the DVM to measure the input signal
- (2) Set the Gain Mode Switch to OFF and adjust the Position Control if necessary for center scale zero baseline.
- (3) Set;
 Attenuator to 1000
 Zero Suppress to -100
 10-Turn Suppress Pot to 10.0
 Gain Mode Sw. to uv/DIV

The Stylus should remain at the center zero baseline (the 100 mv input signal being exactly cancelled by the internal suppress voltage).

- (4) Step the Attenuator through to maximum sensitivity (10), adjusting R32 as necessary to maintain the Stylus position at center scale. (for location of R32, see Figure 4-).

THIS COMPLETES THE RECOMMENDED PREVENTIVE MAINTENANCE PROCEDURE

TSC-820 SIGNAL CONDITIONER

Parts Catalog

INDEX TO CONTENTS OF THIS PARTS CATALOG

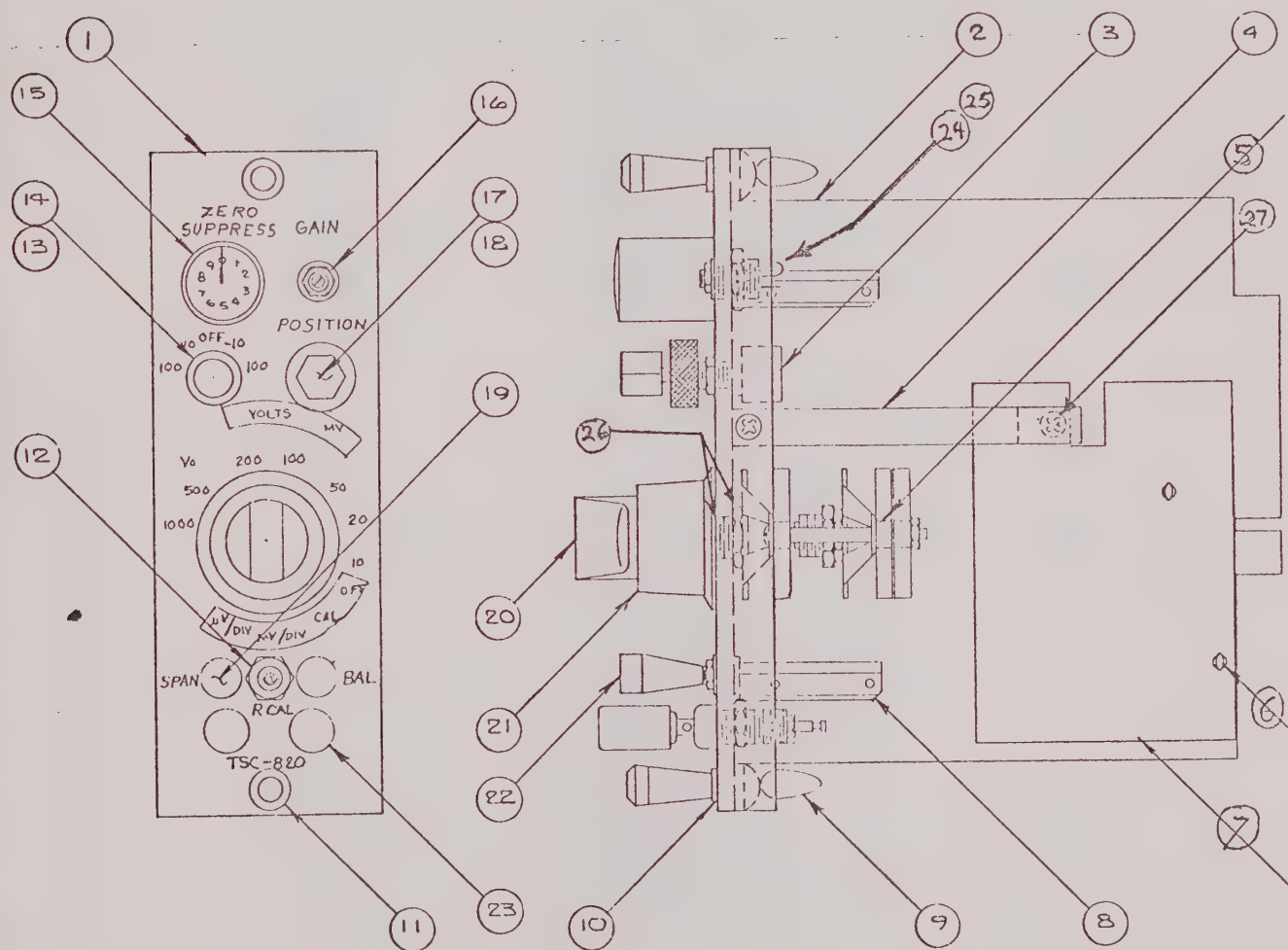
COMPONENTS COVERED	LOCATION IN CATALOG	
	<u>Plate & List</u>	<u>Page</u>
MODULE ASSEMBLY. This is the complete TSC-820 Signal Conditioner, made up of various individual components plus 3 sub-"assemblies".....		2 & 3
Note: Each of the sub-assemblies is detailed separately on additional Plates & Lists as noted below.		
PCB PREAMPLIFIER ASSEMBLY		4 & 5
PCB VOLTAGE REG. ASSEMBLY		6 & 7
ATTENUATOR ASSEMBLY		8 & 9

HOW TO ORDER PARTS

Determine Part Number and Name of each desired component by referring to the appropriate PLATE & LIST. In writing parts orders, it is important always to state the correct PART NUMBER as well as Part Name and quantity wanted, for each item. Also give Signal Conditioner Model and Serial Numbers.

Price quotations, when requested, will be furnished prior to shipment of any order. Unless otherwise specified by customer, parts orders are shipped _____.

Module Assembly
No. 402153



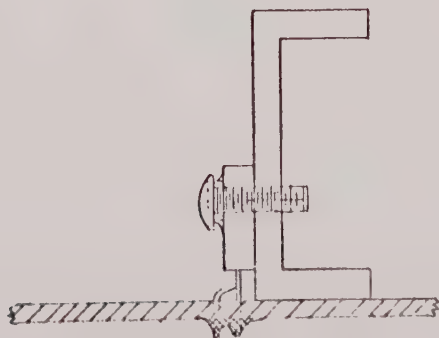
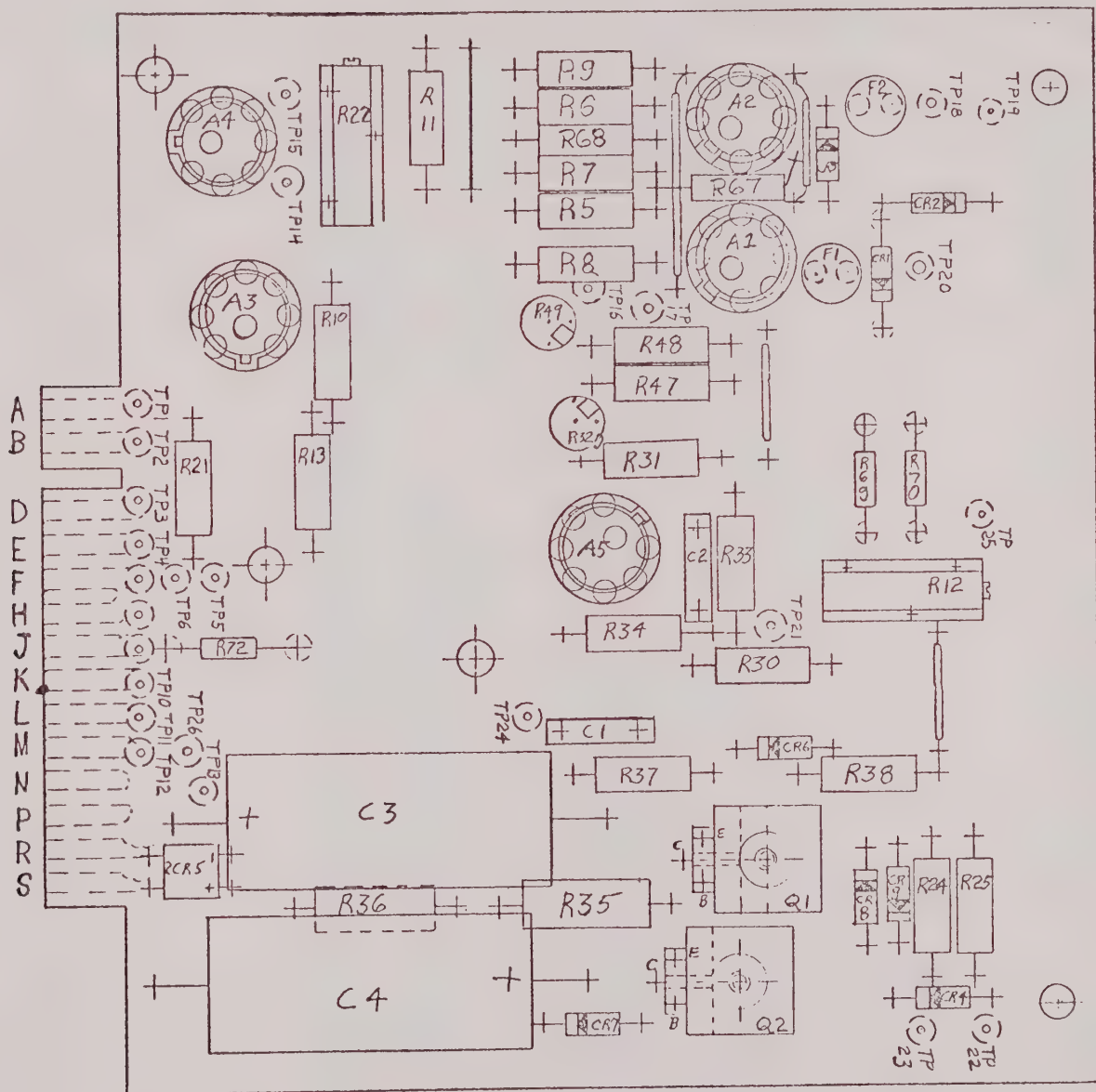
Parts List

Module Assembly No. 402153

FIND No.	Part Number*	Part Name	Notes
1	A-402151	PANEL, Front	
2	402150	ASSEMBLY, Pre-Amp, PC Board	See Plate & List 2
3	107148-203	POTENTIOMETER, Stylus Pos.	RV6LYA
4	107291	STRAP	
5	202897	ASSEMBLY, ATTENUATOR	See Plate & List 4
6	107378 -12N	SUPPORT, Circuit Board	
7	202185	ASSEMBLY, Precision Volt.Reg.	See Plate & List 3
8	107385-203	POTENTIOMETER, Balance	Beckman Model 57R
9	104707	PLUG, Banana	
10	104706	WASHER, Nylon	
11	104705	KNOB, Module Removal	
12	107380-3	SWITCH, R-Cal, Push-Button	Grayhill
13	106736	SWITCH, Zero Supp., Rotary	Alco
14	104670	KNOB, Rotary Switch	
15	1-107381-502	POT. 10-Turn, Zero Suppress	Bourns
16	107382-253	POTENTIOMETER, Gain	Allen-Bradley
17	107149-1	LOCK, Shaft	
18	102023	KNOB, Stylus Position Pot.	
19	107385-501	POTENTIOMETER, Span	
20	107467	KNOB, Atten. Gain Mode Sw.	
21	107383-2	KNOB, Attenuator Switch	
22	107386	KNOB, Bal. Pot.	
23	107379-6	POST, Binding	
24	100549-1542	RESISTOR 1% MF 15.4K	RN 60D
25	100549-1963	RESISTOR 1% MF 196K	RN 60D
26	102066	WASHER, Swedged Fibre	
27	103750-3/4	SPACER, Nylon	

* All Part Numbers in this listing are Gulton Numbers

Pre-Amplifier, P. C. Board Assembly
No. 402150



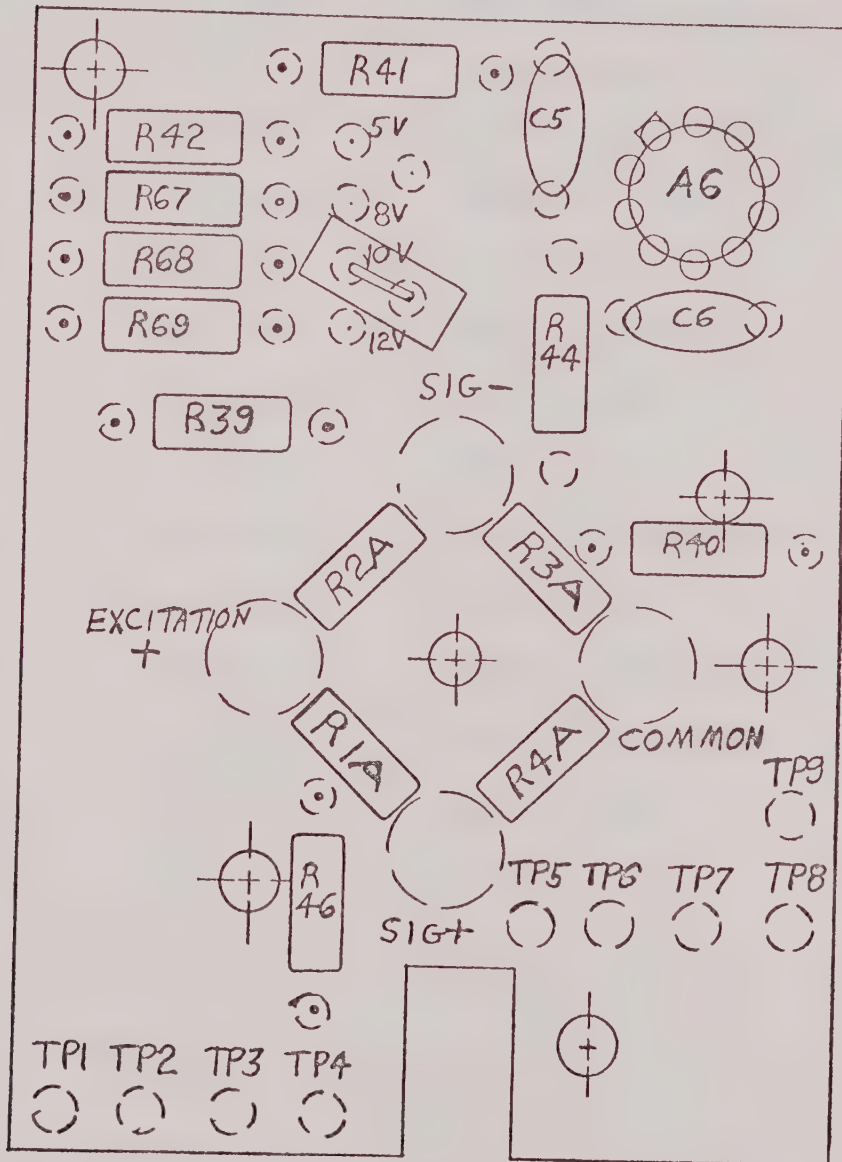
TRANSISTOR MOUNTING

Parts List

Pre-Amplifier P. C. Board Assembly No. 402150

Ref. Designation	Part Number	Part Name/Description	Notes
A1, A2	1-202062	Amplifier, Operational 741L	Analog Devices
A3, A4, A5	201980	Amplifier, Operational AD741K	Analog Devices
C1, C2	103998-684	Capacitor .68 UF	Sprague
C3, C4	104131	Capacitor 530 UF	IEC
CR1, CR2, CR3	106696-911	Diode, Zener 9.1V	IN5066
CR4	104154	Diode, Zener Ref .9V	IN935
CR5	106080-2	Rectifier, Bridge MDA 920-2	Motorola
CR6, CR7	106696-16	Diode, Zener 16V	IN5072
CR8, CR9	10106696-13	Diode, Zener 13V	IN5069
F1, F2	107465	Fuse 1/100 AMP	Bussman
PC1	402152	PC Board	
Q1	103833	Transistor 2N4922	Motorola
Q2	103846	Transistor 2N4918	Motorola
R5, R6	100549-2001	Resistor 2K MF	RN 60D
R7	100549-100R	Resistor 100 Ω MF	RN 60D
(R8, R9) (R10, R11)	10100549-1002	Resistors, Matched Prs. 10K	
R12	103954-103	Trim Pot 10K	Beckman
R13, R34	100549-1002	Resistor 10K	RN 60D
R21	100549-4991	Resistor 4.99K	RN 60D
R22	103954-203	Trimpot 20K 77PR Model	Beckman
R24, R25	100549-499R	Resistor 499 Ω	RN 60D
R30	100549-2492	Resistor 24.9K	RN 60D
R31	100549-4532	Resistor 45.3K	RN 60D
R32	103654-203	Trimpot 20K	Beckman
R33	100549-4992	Resistor 49.9K	RN 60D
R35, R36	100448- 151	Resistor 150 Ω 1Watt	RC32
R37, R38	100556-56R	Resistor 56 Ω 1/4 Watt	RC07
R47	100549-150R	Resistor 150 Ω	RN 60D
R48	100549-9092	Resistor 90.9K	
R49	103654-101	Trimpot 100 Ω 62PR Model	Beckman
R67, R68	100549-1151	Resistor 1.15K MF	RN 60D
R69, 70	100549-2002	Resistor 20K MF	RN 60D
R72	100549-1004	Resistor 1/4W MF 1MEG Ω	RN 60D
Ref.	107377	Heat sinks CQ1 + Q2	

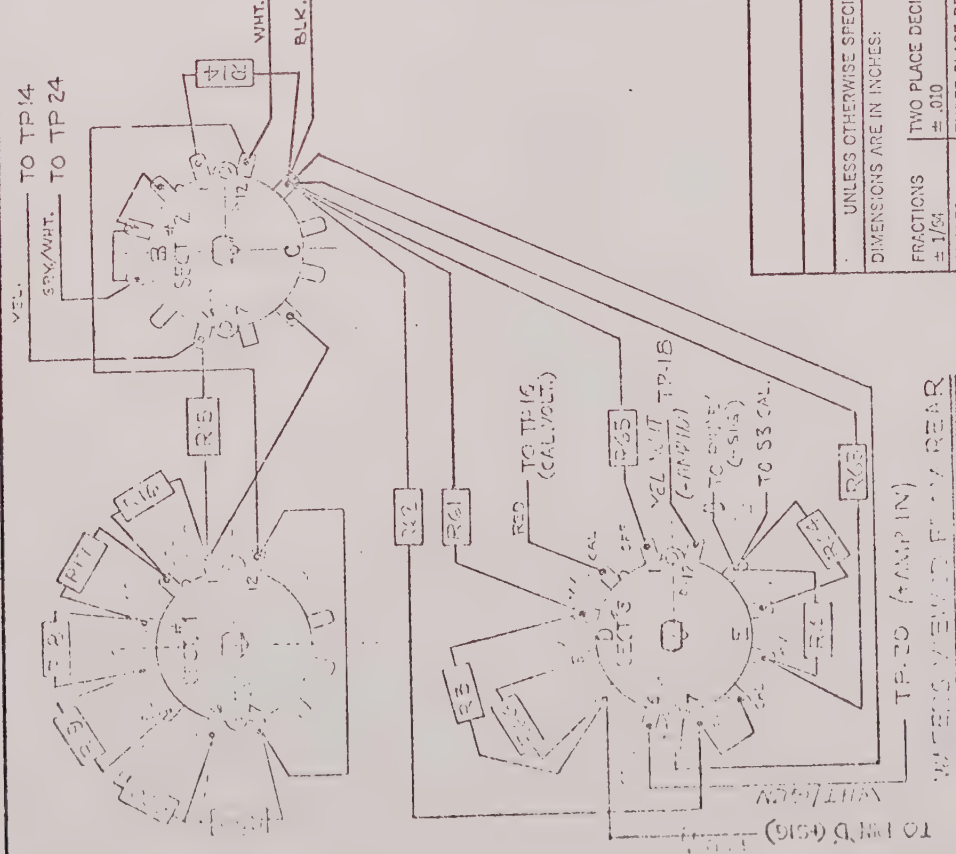
Precision Voltage Regulator Assembly
No. 202185



Parts List

Precision Voltage Regulator Assembly No. 202185

Ref.	Part Number	Part Name/Description	Notes
A6	107372	Voltage Regulator μ A 723	Fairchild
C5	1004840101	Capacitor 100PF, Ceramic $\pm 20\%$	Sprague
C6	100484-103	Capacitor .01 μ F, Ceramic $\pm 10\%$	Sprague
PC1	202188	P. C. Board	
R39	100549-2001	Resistor 1/4W MF 2K $\pm 1\%$	RN60D
R40	100549-1501	Resistor 1/4W MF 1.5K $\pm 1\%$	RN60D
R41	100556-8R2	Resistor 1/4W CC 8.2 $\pm 5\%$	RC07
R42	100549-590R	Resistor 1/4W MF 590 $\pm 1\%$	RN60D
R44	100549-1001	Resistor 1/4W MF 1.0K	RN60D
R46	100549-1003	Resistor 1/4W MF 100K $\pm 1\%$	RN60D
R67	100548-1541	Resistor 1/4W MF 1.54K $\pm 1\%$	RN60D
R68	100549-2151	Resistor 1/4W MF 2.15K $\pm 1\%$	RN60D
R69	100549-2741	Resistor 1/4W MF 2/74K $\pm 1\%$	RN60D



LTR	DESCRIPTION	DATE
A	REVISED FROM PREVIOUS EDITION	11-6-74
B	SECTION 2 REMOVED FROM SECTION 1	11-6-74
C	REMOVED THE PCM FROM THE ATTENUATOR	11-6-74

NOTES: 1. USE SPRING LOADING OVER A FIVE LUG SYSTEM TO PREVENT FROTTING. 2. USE #24 AWG STRAIN IS WIRE, COLOR CODED AS FOLLOWS: USE #24 AWG BUSS WIRE FOR TERMINALS 6-10-15. 3. HIDE DESIGN SEE ONLY

TO TP15 (AMP OUT)
BLK. TO TP19 (COMM)

REF. DESG.	FIND NO.	QUAN REQ	PART NO. OR IDENTIFYING NO.	DESCRIPTION
R66		4	100S49-1001	RESISTOR 1K
R62, R64, R65				
R61, R63		1	1-100S49-1001	RESISTOR 1K
R50		1	100S49-1001	RESISTOR 1K
R20		1	1-100S49-1001	RESISTOR 1K
R19		1	1-100S49-1001	RESISTOR 1K
R18		1	1-100S49-1001	RESISTOR 1K
R17		1	1-100S49-1001	RESISTOR 1K
R15, R16		2	1-100S49-1001	RESISTOR 1K
R14		1	100S49-1001	RESISTOR 1K
R3, R4		1	1-100S49-1001	RESISTOR 1K
S1		1	2010M	SWITCH, 2010M

REF. DESG.	FIND NO.	QUAN REQ	PART NO. OR IDENTIFYING NO.	DESCRIPTION
------------	----------	----------	-----------------------------	-------------

PARTS LIST

DRAWN BY: E. P. RICK
DATE: 11-6-74
CHECKED BY: A. J.
DATE: 11-2-74
CONTRACTOR CERTIFICATION:
DATE:
DESIGN APPROVAL:
DATE:
DOCUMENTATION APPROVAL:
DATE:

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES:

FRACTIONS	TWO PLACE DECIMALS
$\pm 1/64$	$\pm .010$
ANGLES	THREE PLACE DECIMALS
$\pm 1'$	$\pm .005$

REMOVE ALL BURRS AND SHARP EDGES.
DIMENSIONS AND TOLERANCES SHALL BE HELD AFTER PLATING.
MACHINE SURFACES TO BE $\sqrt{63}$ RMS.
MATERIAL: 11-6-74

REORDER BY SYSTEM DIVISION
Cation Industries Inc.
ATTENUATOR ASSEMBLY

OCDE IDENT	SIZE	DWG NO.
C4	B	202597

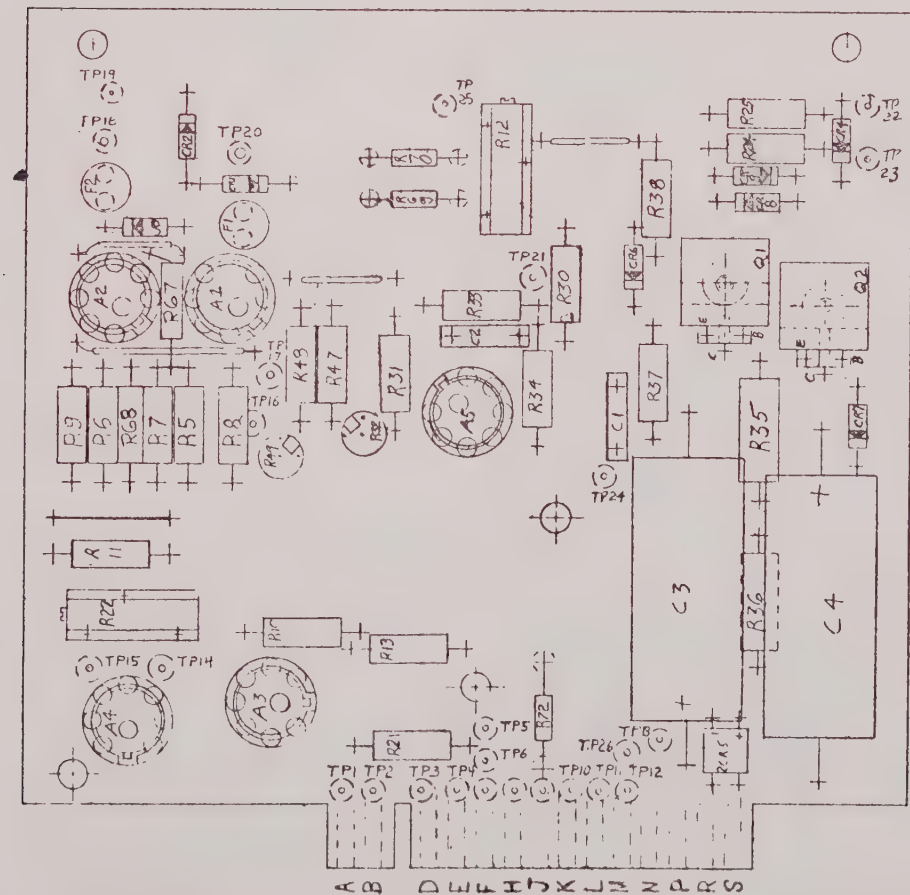
SCALE	CONTRACT NO.	SHEET
		OF

NEXT ASSY	USED ON

Parts List

Attenuator Assembly No. 202897

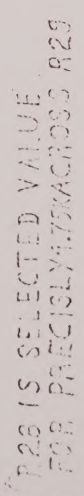
Ref.	Part Number	Part Name/Description	Notes
R66	100549-1001	Resistor 1K	
R62, R64 R65, R61 R63	1-100549-1001	Resistor 1K (Match'D. PR.) <i>2</i>	
R50	100549-1243	Resistor 124K	
R20	100549-7502	Resistor 75K	
R19	100549-2492	Resistor 24.9K	
R18	100549-1242	Resistor 12.4K	
R17	100549-7501	Resistor 7.5K	
R15, R16	100549-2491	Resistor 2.49K	
R14	100549-4991	Resistor 4.99K.	
R3, R4	1-100549-1004	Resistor 1 MEG. (Match'D. PR)	
S1	202871	Switch, Rotary	



R72	1	44	100K 1/4W 1% ME	RESISTOR 100K 1/4W 1% ME
R7	43	1000P 50V 10% ME	RECEPTOR	RECEPTOR
FL1	42	104537	RECEPTOR	RECEPTOR
FL2	41	104537	FUSE 100 AMP	FUSE 100 AMP
	40			
	39	104305	TRANSISTOR PAO	TRANSISTOR PAO
	38	104305	LOCK WASHING	LOCK WASHING
	37	104305	DO NOT USE	DO NOT USE
	36	104305	SCHEMATIC	SCHEMATIC
R32	35	103654-203	TRIMPOT 20K	TRIMPOT 20K
R49	34	103654-101	TRIMPOT 100K	TRIMPOT 100K
R48	33	103654-202	RESISTOR 100K	RESISTOR 100K
R47	32	100549-150R	RESISTOR 150K	RESISTOR 150K
	31			
	30			
R12	29	103954-103	TRIMPOT 10K	TRIMPOT 10K
PC1	28	402152	PC BOARD	PC BOARD
	27		WASHERS, CUP	WASHERS, CUP
	26	107577	HEAT SINK	HEAT SINK
R37, R38	25	100556-56R	RESISTOR 56K	RESISTOR 56K
R35, R36	24	100549-151	RESISTOR 150K	RESISTOR 150K
R33	23	100549-4892	RESISTOR 489K	RESISTOR 489K
R31	22	100549-453K	RESISTOR 453K	RESISTOR 453K
R30	21	100549-2492	RESISTOR 249K	RESISTOR 249K
R24, R25	20	100549-439R	RESISTOR 439K	RESISTOR 439K
R21, R22	19	100549-4891	RESISTOR 489K	RESISTOR 489K
	18	100549	RESISTOR 10K	RESISTOR 10K
R22	17	103954-203	TRIMPOT 20K	TRIMPOT 20K
C3, R9, R10, R11	16	100549-1002	RESISTORS MATCHED PAIRS 10K	RESISTORS MATCHED PAIRS 10K
R67, R68	15	100549 1151	RESISTOR 115K ME	RESISTOR 115K ME
R5, R6	14	100549-2001	RESISTOR 20K ME	RESISTOR 20K ME
	13			
Q2	12	103846	TRANSISTOR 2N4216	TRANSISTOR 2N4216
Q1	11	103846	TRANSISTOR 2N4216	TRANSISTOR 2N4216
C3, C4	10	100549-13	DIODE ZENER 13V	DIODE ZENER 13V
C4, C7	9	100549-16	DIODE ZENER 16V	DIODE ZENER 16V
C5	8	100549-2	BRIDGE RECTIFIER	BRIDGE RECTIFIER
C4	7	104154	DIODE ZENER 25.5V	DIODE ZENER 25.5V
C1, C2, C3	6	100549-9.1	DIODE ZENER 9.1V	DIODE ZENER 9.1V
C3, C4	5	104154	CAPACITOR 500P	CAPACITOR 500P
C1, C2	4	103846	CAPACITOR 100K ME	CAPACITOR 100K ME
R69, R70	3	100549-2002	RESISTOR 200K ME	RESISTOR 200K ME
A3, A4, A5	2	201380	AMPLIFIER OPERATIONAL 407418	AMPLIFIER OPERATIONAL 407418
A1, A2	1	1020202	AMPLIFIER OPERATIONAL 741L	AMPLIFIER OPERATIONAL 741L

UNLESS OTHERWISE SPECIFIED			DRAWN BY: <u>Galen</u>			DATE		PARTS LIST	
DWG CODE	SIZE	IDENT	SPECIFICATIONS	REF. DES.	QUAN	REQ	IND	PART NO. OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION
DIMENSIONS ARE IN INCHES:									
FRACTIONS ON:									
TWO PLACE DECIMALS									
± .010									
THREE PLACE DECIMALS									
± .005									
ANGLES									
± 1°									
REMOVE ALL BURRS AND SHARP EDGES									
DIMENSIONS AND TOLERANCES SHALL									
BE HELD AFTER PLATING. B3									
MACHINE SURFACES TO BE V. RMS.									
MATERIAL									
DESIGN APPROVAL:							SIZE	CODE IDENT	DWG NO.
DOCUMENTATION APPROVAL:							SCALE	CONTRACT NO.	

TRANSISTOR MOUNTING



Callon
SACCHININ-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37-38-39-40-41-42-43-44-45-46-47-48-49-50-51-52-53-54-55-56-57-58-59-60-61-62-63-64-65-66-67-68-69-70-71-72-73-74-75-76-77-78-79-80-81-82-83-84-85-86-87-88-89-90-91-92-93-94-95-96-97-98-99-100-101-102-103-104-105-106-107-108-109-110-111-112-113-114-115-116-117-118-119-120-121-122-123-124-125-126-127-128-129-130-131-132-133-134-135-136-137-138-139-140-141-142-143-144-145-146-147-148-149-150-151-152-153-154-155-156-157-158-159-160-161-162-163-164-165-166-167-168-169-170-171-172-173-174-175-176-177-178-179-180-181-182-183-184-185-186-187-188-189-190-191-192-193-194-195-196-197-198-199-200-201-202-203-204-205-206-207-208-209-210-211-212-213-214-215-216-217-218-219-220-221-222-223-224-225-226-227-228-229-230-231-232-233-234-235-236-237-238-239-240-241-242-243-244-245-246-247-248-249-250-251-252-253-254-255-256-257-258-259-260-261-262-263-264-265-266-267-268-269-270-271-272-273-274-275-276-277-278-279-280-281-282-283-284-285-286-287-288-289-290-291-292-293-294-295-296-297-298-299-300-301-302-303-304-305-306-307-308-309-310-311-312-313-314-315-316-317-318-319-320-321-322-323-324-325-326-327-328-329-330-331-332-333-334-335-336-337-338-339-340-341-342-343-344-345-346-347-348-349-350-351-352-353-354-355-356-357-358-359-360-361-362-363-364-365-366-367-368-369-370-371-372-373-374-375-376-377-378-379-380-381-382-383-384-385-386-387-388-389-390-391-392-393-394-395-396-397-398-399-400-401-402-403-404-405-406-407-408-409-410-411-412-413-414-415-416-417-418-419-420-421-422-423-424-425-426-427-428-429-430-431-432-433-434-435-436-437-438-439-440-441-442-443-444-445-446-447-448-449-450-451-452-453-454-455-456-457-458-459-460-461-462-463-464-465-466-467-468-469-470-471-472-473-474-475-476-477-478-479-480-481-482-483-484-485-486-487-488-489-490-491-492-493-494-495-496-497-498-499-500-501-502-503-504-505-506-507-508-509-510-511-512-513-514-515-516-517-518-519-520-521-522-523-524-525-526-527-528-529-530-531-532-533-534-535-536-537-538-539-540-541-542-543-544-545-546-547-548-549-550-551-552-553-554-555-556-557-558-559-560-561-562-563-564-565-566-567-568-569-570-571-572-573-574-575-576-577-578-579-580-581-582-583-584-585-586-587-588-589-590-591-592-593-594-595-596-597-598-599-600-601-602-603-604-605-606-607-608-609-610-611-612-613-614-615-616-617-618-619-620-621-622-623-624-625-626-627-628-629-630-631-632-633-634-635-636-637-638-639-640-641-642-643-644-645-646-647-648-649-650-651-652-653-654-655-656-657-658-659-660-661-662-663-664-665-666-667-668-669-670-671-672-673-674-675-676-677-678-679-680-681-682-683-684-685-686-687-688-689-690-691-692-693-694-695-696-697-698-699-700-701-702-703-704-705-706-707-708-709-710-711-712-713-714-715-716-717-718-719-720-721-722-723-724-725-726-727-728-729-730-731-732-733-734-735-736-737-738-739-740-741-742-743-744-745-746-747-748-749-750-751-752-753-754-755-756-757-758-759-760-761-762-763-764-765-766-767-768-769-770-771-772-773-774-775-776-777-778-779-780-781-782-783-784-785-786-787-788-789-790-791-792-793-794-795-796-797-798-799-800-801-802-803-804-805-806-807-808-809-810-811-812-813-814-815-816-817-818-819-820-821-822-823-824-825-826-827-828-829-830-831-832-833-834-835-836-837-838-839-840-841-842-843-844-845-846-847-848-849-850-851-852-853-854-855-856-857-858-859-860-861-862-863-864-865-866-867-868-869-870-871-872-873-874-875-876-877-878-879-880-881-882-883-884-885-886-887-888-889-890-891-892-893-894-895-896-897-898-899-900-901-902-903-904-905-906-907-908-909-910-911-912-913-914-915-916-917-918-919-920-921-922-923-924-925-926-927-928-929-930-931-932-933-934-935-936-937-938-939-940-941-942-943-944-945-946-947-948-949-950-951-952-953-954-955-956-957-958-959-960-961-962-963-964-965-966-967-968-969-970-971-972-973-974-975-976-977-978-979-980-981-982-983-984-985-986-987-988-989-990-991-992-993-994-995-996-997-998-999-1000-1001-1002-1003-1004-1005-1006-1007-1008-1009-1010-1011-1012-1013-1014-1015-1016-1017-1018-1019-1020-1021-1022-1023-1024-1025-1026-1027-1028-1029-1030-1031-1032-1033-1034-1035-1036-1037-1038-1039-1040-1041-1042

P28 IS SELECTED VALUE
FOR PRECISELY 4.75KACROSS R29



Measurement & Control Systems Division

Gulton Industries Inc., East Greenwich, Rhode Island 02818
401-884-6800 • TWX 710-387-1500